

A Visual Identification Guide to the Gammaridean Amphipods of Morro Bay, CA
Order Amphipoda
Suborder Gammaridea

Caitrin Phillips
California Polytechnic State University San Luis Obispo
Professor Dean Wendt

Table of Contents

1. Introduction	
a. Introduction to the Guide.....	1
b. Morphology and ecology.....	2
2. Methods.....	3
3. Key to Gammaridean Families of Morro Bay.....	5
4. Guide to Gammaridean Amphipods by Family	
Family Aoridae	7
Aoroides sp.	
Family Ampeliscidae.....	8
Ampelisca lobata	
Family Ampithoidae.....	10
Ampithoe lacertosa	
Family Corophiidae.....	11
Laticorophium baconi	
Monocorophium acherusicum	
Monocorophium insidiosum	
Family Eusiridae.....	15
Pontogeneia intermedia	
Family Ischyroceridae.....	16
Jassa slatteryi	
Jassa marmorata	
Erichthonius brasiliensis	
Family Isaeidae.....	21
Gammaropsis sp.	
Gammaropsis thompsoni	
Photis sp.	
Family Melitidae.....	25
Elasmopus sp.	
Family Podoceridae.....	26
Podocerus brasiliensis	
Podocerus cristatus	
Podocerus spongicolus	
Family Stenothoidae	30
Stenothoe estacola	
Stenothoe frecanda	
5. Glossary of Terms.....	32
6. References.....	36

Introduction

Introduction to the Guide

Gammaridean amphipods are the most abundant and familiar suborder of the Order Amphipoda. They represent a very diverse group of organisms with a worldwide range and a species count reaching 5,700 species in 1060 genera (Barnard & Karaman 1991). They are exceedingly abundant in marine systems reaching densities of 3 gammarids/cm² on fouling plates (Needles and Wendt unpublished data). Even though they are extremely abundant, they have proven to be a difficult group to identify due to their small size and morphology. In environmental surveys, identification of gammarid amphipods present themselves as an important challenge. In the past, they have been grouped as just Amphipods or Gammaridean Amphipods to save time and avoid the process of identification. This guide provides a resource for the identification of common Gammaridean Amphipods found in Morro Bay, California. It does not necessarily represent the total diversity of Gammaridean amphipods that can be found in Morro Bay but rather is a general overview of the Gammarids that were found in the most recent survey of Morro Bay, CA (Needles 2007). This survey was conducted between 2004-2006 and focused mainly on the fouling community.

The advantage of this guide is that it provides pictures of the specimens and key identifying characteristics. For accurate identification it should be used in conjunction with other keys as it does not represent all of the gammarid amphipods that may be encountered. In addition, the taxonomy and systematics of this group can be inconsistent and confusing; presently there is no completely agreed upon familial arrangement for the gammaridean amphipods. This guide provides a clear and current picture of the grouping

of the species within the Suborder Gammaridean, and uses Barnard & Karaman's 1991 collection as the foundation. Finally, the species presented in this guide that have been identified as invasive to the Morro Bay region, are clearly labeled.

Morphology and Ecology of Gammaridean Amphipods

Amphipods are characterized by three traits; 1) the absence of a carapace, 2) the first thoracic segment being fused to the head, and 3) the abdomen being divided into two parts each with three segments. Gammaridean amphipods are usually laterally compressed. Most are benthic but there are some planktonic species. The "typical" gammaridean has large coxal plates, a large abdomen with six pairs of appendages, and relatively small compound eyes (Fig. 1). There is divergence from the typical body plan, making gammarids a broad and diverse group with respect to morphology. For more detail on the general body structure see Figure 1.

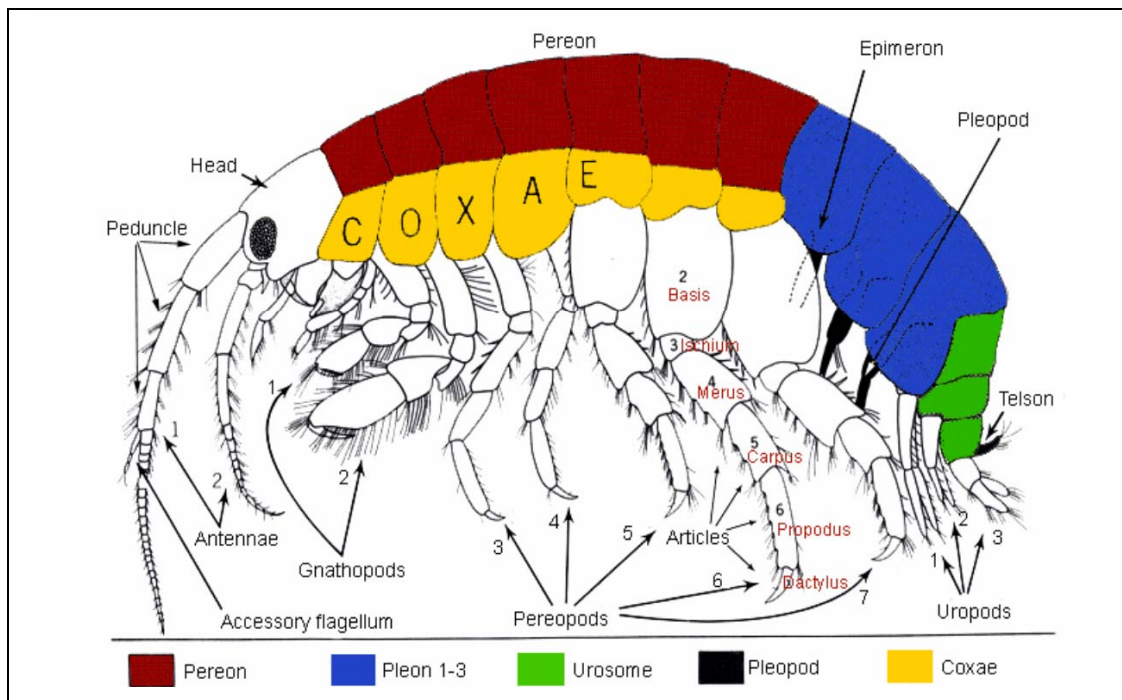


Figure 1: General Morphology of a Gammaridean Amphipod. Adapted from Barnard and Karaman. 1991. The Families and Genera of Marine Gammaridean Amphipoda (Except Marine Gammaroids). Records of the Australian Museum, 13(1&2): 1-866.

Gammarideans fill an interesting ecological niche within any ecosystem. They can display high population densities, as well as high species diversity in a single area. Gammarideans can be scavengers, suspension feeders, or predators. Many species construct and live in tubes made of various substrates that are cemented together by secretions of glands on their fourth and fifth pereopods (Conlan, 1986). In addition, they can live commensally with other invertebrates or be parasitic on other invertebrates.

Reproduction is achieved through external fertilization, and mating behavior varies. Typically, the male locates a preparturial female by using his antennae to detect pheromones from the female. The male then rides, or carries, the female with her dorsum

facing his venter for several days. The female goes through a parturial molt, signaling her ability to mate. Fertilization occurs in the marsupium where eggs are then brooded and ventilated by the beating of the pleopods. Amphipods undergo direct development, and average twenty molts in a typical one-year life cycle (Rupert et al 2004)

Methods

The specimens included in this key were all collected from within Morro Bay, CA. Morro Bay is a small estuary on the California Central Coast, located centrally between Los Angeles and San Francisco. Specimens were collected by three different methods; 1) they were taken off of recruitment plates that had been placed in the bay, 2) directly taken off the substrate, or 3) found accidentally through the collection of other organisms. All the amphipods were originally preserved in 10% buffered formalin, and then transferred to 70% ethanol solution for long-term storage. A compound and dissecting microscope were used for examination of specimens. Species identification was determined by use of identification guides (i.e. Lights Manual) and by taxonomists (Pers comm. Peter Slattery, Moss Landing Marine Laboratory). Dissection was avoided if possible to preserve the integrity of the specimens. However, it was not always possible to avoid dissection of specimens. For step-by-step instructions on amphipod dissection see Lights Manual. A Canon D Digital Camera was used for the digital photographs, and Adobe Photoshop was used to clean up the pictures.

Key to Gammaridean Amphipod Families of Morro Bay

1a. Telson fleshy, thickened, entire*	2
1b. Telson thin, flattened, cleft or uncleft	7
2a. Gnathopod 1 larger than Gnathopod 2	Aoridae
2b. Gnathopod 1 equal or less than Gnathopod 2	3
3a. Uropod 3 reduced or absent, urosomite 1 elongate (2x urosomite 2)	Podoceridae
3b. Uropod 3 present	4
4a. Outer ramus of Uropod 3 hooked	5
4b. Outer ramus of Uropod 3 not hooked	6
5a. Outer ramus of Uropod 3 stout, with 2 hooked spines; inner ramus flat and setose	Ampithoidae
5b. Outer ramus of Uropod 3 slim, a single hook and with fine teeth apically, inner ramus lacking setae	Ischyroceridae
6a. Male antennae 2 stout and enlarged, lacking accessory flagellum; Urosome visibly depressed/ flattened	Corophiidae
6b. Male antennae 2 not stout and enlarged	Isaeidae
7a. Uropod 3 uniramus, coxae enlarged and overlapping	Stenothoidae
7b. Uropod 3 biramus	8
8a. Accessory flagellum either 1-2 short articles or absent	9
8b. Accessory flagellum present and longer than 2 articles, Uropod 1 peduncle with 1-2 robust setae	Melitidae
9a. Accessory flagellum absent, eyes present as two pairs of cuticular lenses, pereopod 5 shorter and of different structure than pereopod 4	Ampeliscaidae

9b. Accessory flagellum 1-2 short articles, a scale, or absent; telson elongated and cleft.....Eusiridae

*Superfamily Corophioidea according to J.L. Barnard and Karaman (1991) binds together those families with an entire fleshy telson. The telson is described as thickly attached at the base and commonly immobile, the telson can be bi-lobed but it is never completely cleft. On top of this most Corophioideans live in tubes constructed by a lipoprotein threads secreted from glands in their 3 and 4th pereopods.

Family Aoridae

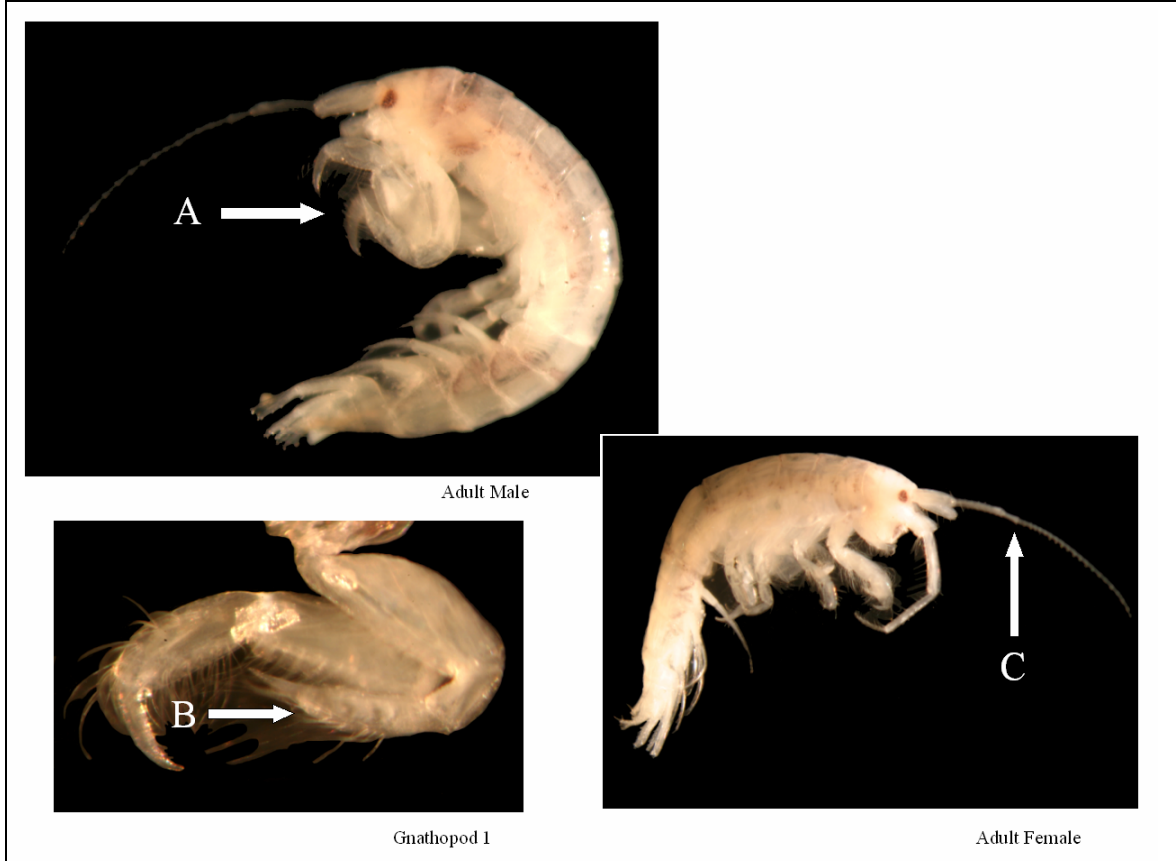


Figure 2. *Aoroides* sp. A. Male Gnathopod 1 larger than Gnathopod 2; B. Gnathopod 1 with merus that extends as a long tooth below carpus; c. Accessory flagella absent.

Aoroides sp. Walker

Distinguishing Characteristics

- A. Male Gnathopod 1 larger than Gnathopod 2
- B. Male Gnathopod 1 with merus that extends as a long tooth below carpus
- C. Accessory flagella absent

Condition

Adult Male missing second antennae and one of the Antennae 1, not all pereopods in tact. Adult Female missing one of the first antennae. Could be either *A. exilis* or *A. inermis*, with obtained specimens unable to be sure.

Description

Article 3 of antenna 1 shorter than article 1, accessory flagellum absent; male gnathopod 1 completely subchelate with long tooth on article 4, articles 5-6 lacking teeth, article 6 shorter and narrower than 5, simple, female gnathopod 1 scarcely subchelate; male gnathopod 2 not heavily setose, articles 5-6 subequal, subchelate; rami of uropod 3 subequal, as long as peduncle. (Barnard, 1969)

Family Ampeliscidae

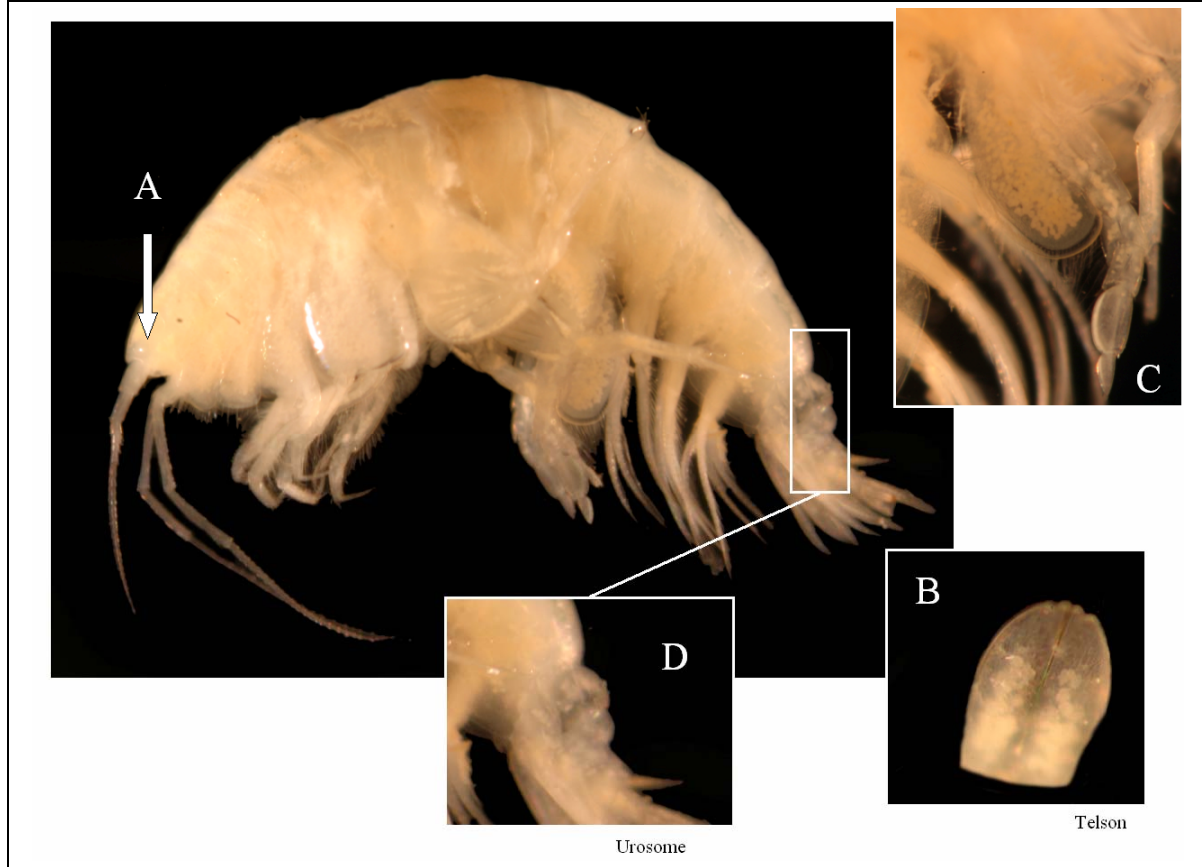


Figure 3. *Ampelisca lobata*. A. Internal eyes with 4 faint corneal lenses; B. Telson cleft, thin and laminar; C. Pereopod 7, article 5 anterior margin not notched.

Ampelisca lobata Holmes, 1908

Distinguishing characteristics

- A. Internal eyes with 4 faint corneal lenses
- B. Telson cleft, thin/laminar
- C. Pereopod 7, article 5 anterior margin not notched
- D. Urosome having a carina-like rounded structure where urosomite 1 unites with urosomites 2-3.

Description

Body small to medium-sized (7-9mm). Antennae 1 reaching beyond end of peduncle of antennae 2, peduncle articles 1 and 2 subequal. Antennae 2 about two-thirds length of body, peduncle article 4 longest. Coxae 1-3 posteroventral corner with small slit. Pereopods 5-6 article 5 posterior margins with 3 groups of setae. Pereopod 7 article 2 posterior lobe deep and slender, not reaching junction of articles 4 and 5; article 3 shorter than article 4 (not including posterior lobe); article 5 without distal notch on anterior margin, subequal in length to article 6. Epimeral plate 3 with curving posterior margin leading to quadrate posteroventral corner. Urosomite 1 with slight rounded carina,

posterior of which meets raised anterior margin of urosomite 2. Uropod 1 rami reaching beyond end of uropod 2. Telson lobes with apices notched laterally and bearing a single seta; dorsal surface with 2-3 pairs of setae. (Blake et al, 1995)

Family Ampithoidae

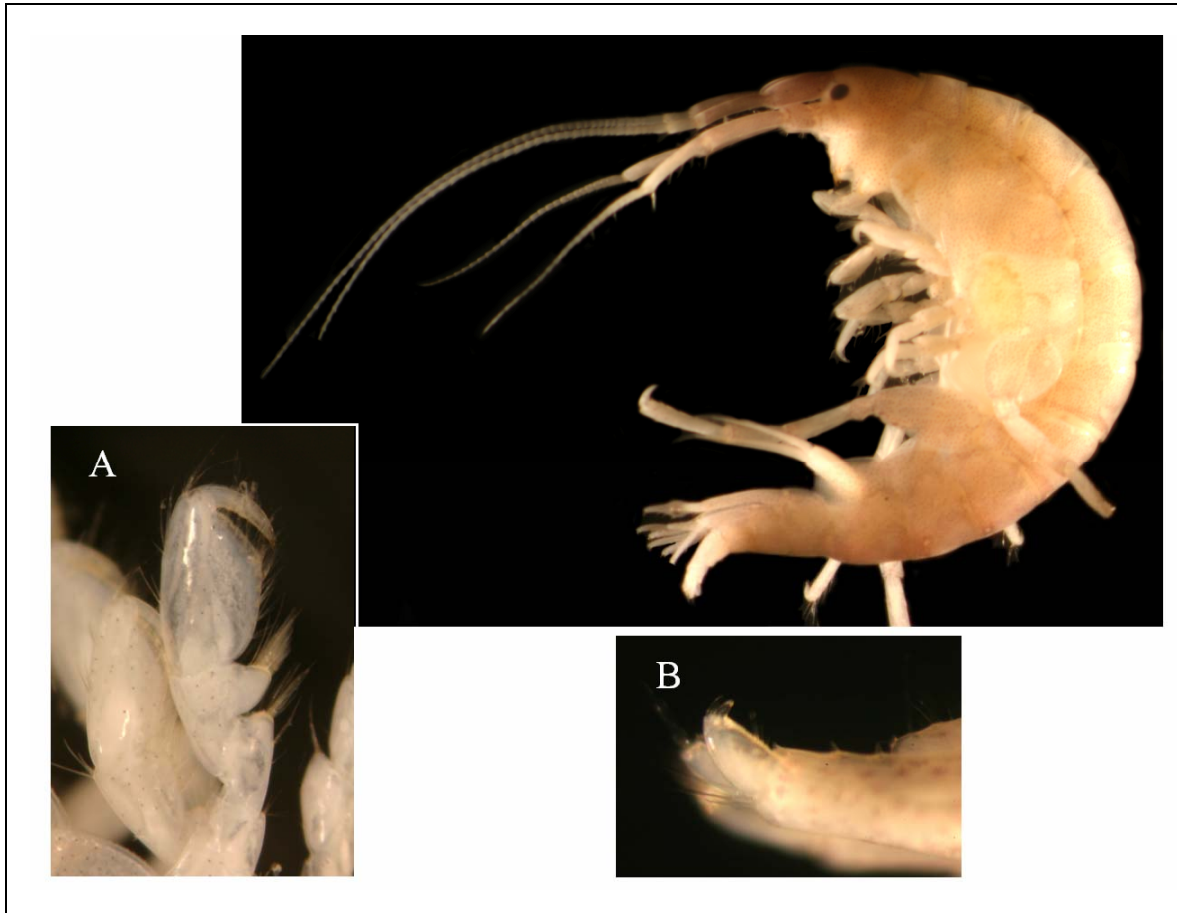


Figure 4. *Ampithoe lacertosa*. A. Adult male Gnathopod 2 with a transverse palm; B. Outer ramus of Uropod 3 stout with 2 hooked spines.

Ampithoe lacertosa Bate, 1958

Distinguishing characteristics

- A. Adult Male Gnathopod 2 with a transverse palm (dactylus lies across palm)
- B. Outer ramus of Uropod 3 stout with 2 hooked spines, inner ramus flat and apically setose

Description

Antenna 1 lacking accessory flagellum; mandible with palp; gnathopods subchelate, gnathopod 2 equal to or larger than 1, with a transverse palm; article six or pereopods 3-5 scarcely widened apically, rarely prehensile; outer ramus or uropod 3 with two hooks; inner ramus or uropod 3 flat and apically setose. (Barnard, 1969)

Family Corophiidae

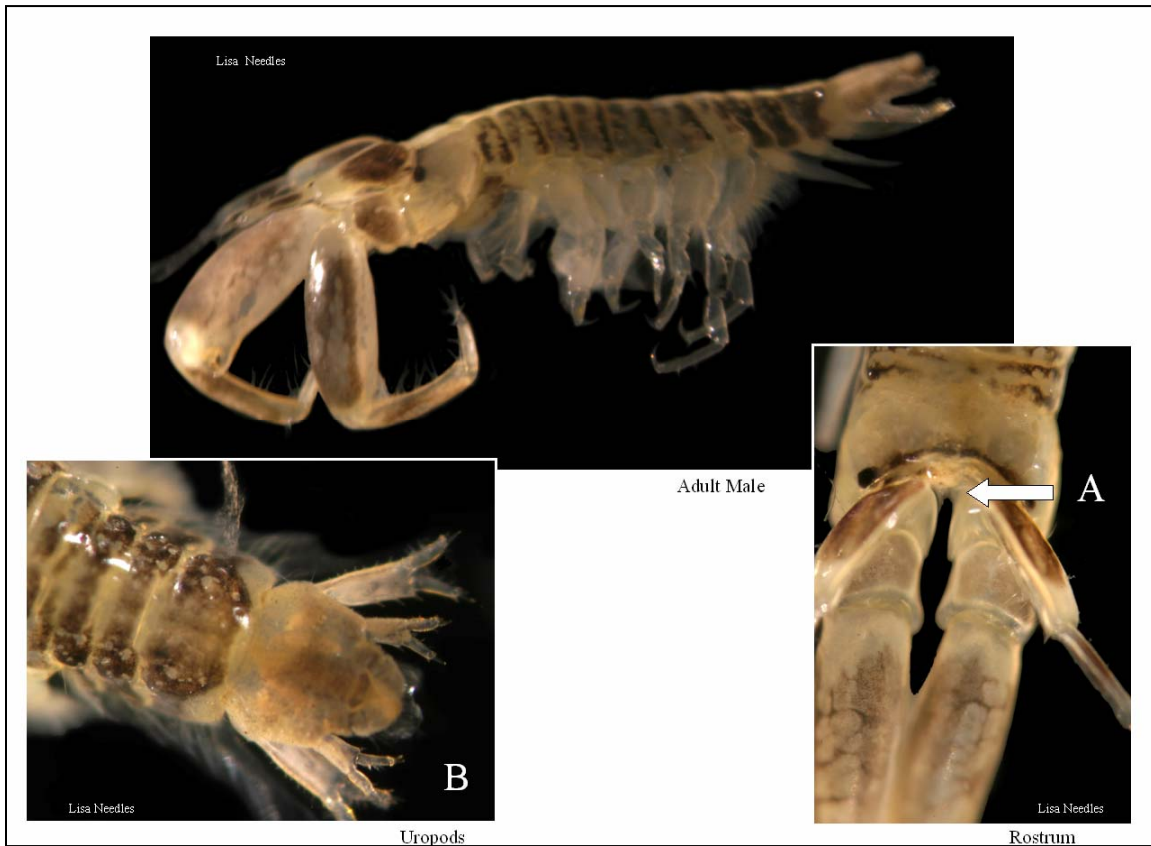


Figure 5. *Monocorophium acherisicum*. A. Male rostrum absent or minute (compare to *M. insidiosum*); B. Uropod 1 attached at invaginations laterally, lacking rim on urosome (compare to *L. baconi*).

Monocorophium acherisicum Costa, 1851

* Invasive to Morro Bay, CA

Distinguishing Characteristics

A. Male rostrum absent or minute

B. Uropod 1 attached at invaginations laterally, lacking rim on urosome

*Females inseparable from *Monocorophium insidiosum*

Description

Male: Pleosome segment 3 dorsally smooth. Urosome with distinct lateral notch; uropod 1 inserted mainly laterally. Head, rostrum very short; recessed posterior to lateral lobes of head. Antennae 1, peduncular segment 1 smooth, bulging proximally, narrowing distally; flagellum slender, 7-9 segmented. Antennae 2 strongly pediform; peduncular segment 5 shorter than 4, with broad distal process, posterior margin with small proximal tooth but few setae; flagellum, short, weakly setose. Gnathopod 1, peropod not narrowing distally, dactyl tip little exceeding palm. Gnathopod 2, basis medium broad; carpus short, deep, with distinct postero-distal free margin; peropod with distinct postero-distal cusp; dactyl with 2-3 unequal posterior marginal teeth. Pereopods 3 & 4, basis broad, anterior margin bare; segment 4 medium, lacking anterior marginal setae; dactyl slender, longer than segment 6. Peraeopods 5, basis small, hinder margin not setose. Pereopod 7 not elongate, basis medium broad; segment 6 not strongly setose distally; dactyl short. Pleon plates 1-3

weakly (or not) setose below. Uropod 1, rami short, unequal, each with 4-6 outer marginal spines. Uropod 2 short, rami each with 1(2) outer marginal spine(s). Uropod 3, peduncle with small nearly bare lateral lobe. Telson short, broad, with 3-4 postero-dorsal pairs of small spines. Female (3.5mm): Rostrum short, broad, apex about level with lateral head lobes. Antennae 1, peduncular segment 1 with numerous strong median and posterior spines. Antenna 2, peduncular segments short, stout; segment 4, posterior margin with 3-4 pairs of strong spines; segment 5, posterior margin with 2 spine groups and clusters of setae; flagellum short, with whorls of setae. (Bousfield, 1997)

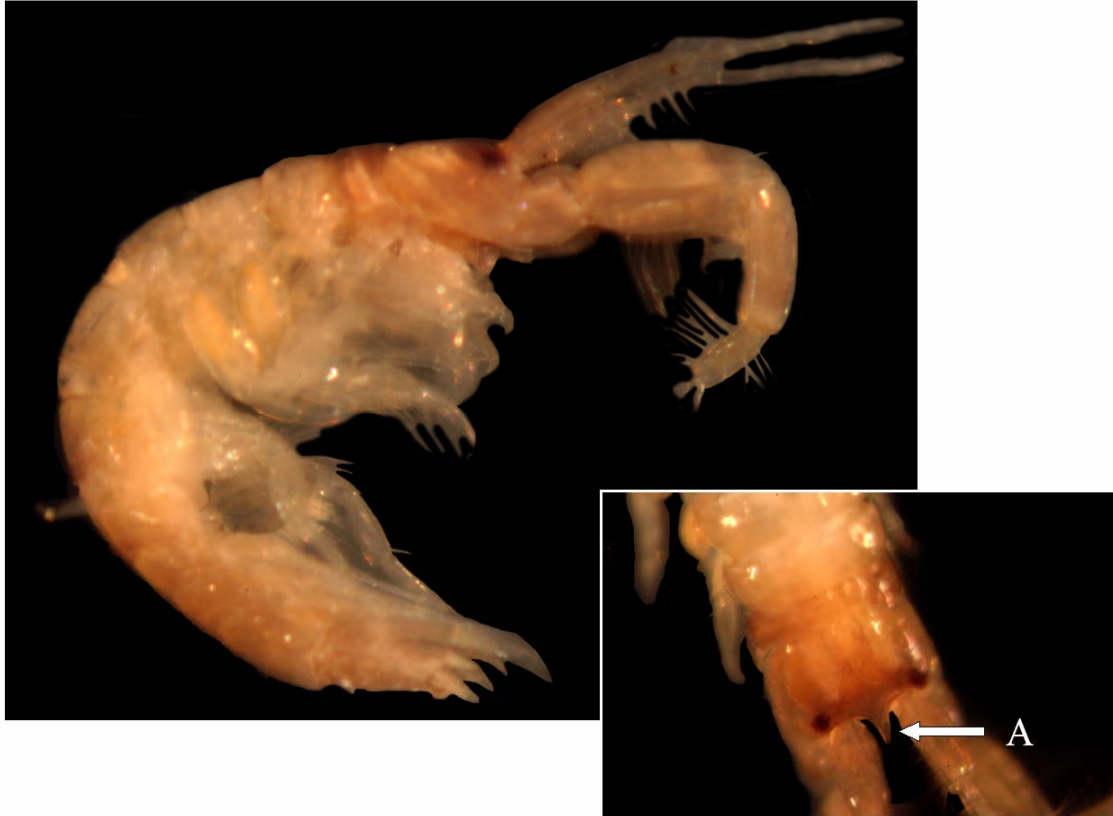


Figure 6. *Monocorophium insidiosum* A. Male rostrum strong, projecting beyond lateral lobe of head; B. Body shape similar to *M. acherisicum*

Monocorophium insidiosum Crawford, 1937

*Invasive to Morro Bay

Distinguishing Characteristics

- A. Male rostrum strong projecting beyond lateral lobe of head
- B. Uropod 2, outer ramus with distinct outer marginal spine

Description

Male: Pleosome segment 3 with low posterior median tufted process or hump. Urosome with distinct lateral notch; uropod 1 inserted laterally. Head, rostrum elongate, tip distinctly exceeding lateral head lobes. Antenna 1, peduncle segment 1 with inner marginal conical process; flagellum 7-8 segmented. Antenna 2 strongly pediform; peduncular segment 5 not shorter than 4, with small proximal median tooth and distal process; flagellum 3-segmented, posterior margin strongly setose. Gnathopod 1, dactyl tip little exceeding palm. Gnathopod 2, basis stout; carpus short, with short postero-distal free margin; propod lacking poster-distal cusp; dactyl with 3 unequal posterior marginal teeth. Pereopods 3 and 4, anterior margin of basis and segment 4 moderately to strongly setose; dactyls curved, shorter than segment 6. Pereopods 5 and 6, bases setose postero-distally. Pereopod 7 not elongate, basis medium broad; distal segments weakly setose; dactyl short. Uropod 1, rami short, unequal, each with 3 outer marginal spines. Uropod 2 short, outer ramus with 1 outer marginal spine, inner ramus bare. Uropod 3, peduncle with small setose lateral lobe. Telson broader than long, with 4 postero-dorsal pairs of

small hook spines. Female: Rostrum short, not exceeding lateral head lobes. Antenna 1, peduncular segment 1 with 3-4 median spines. Antenna 2, peduncular segments short, stout; segment 4, posterior margin with 3 pairs of strong spines; flagellum weakly setose posteriorly. Peraeopods 3 and 4, anterior margins of basis and segment 4 relatively sparsely setose. (Bousfield, 1997)

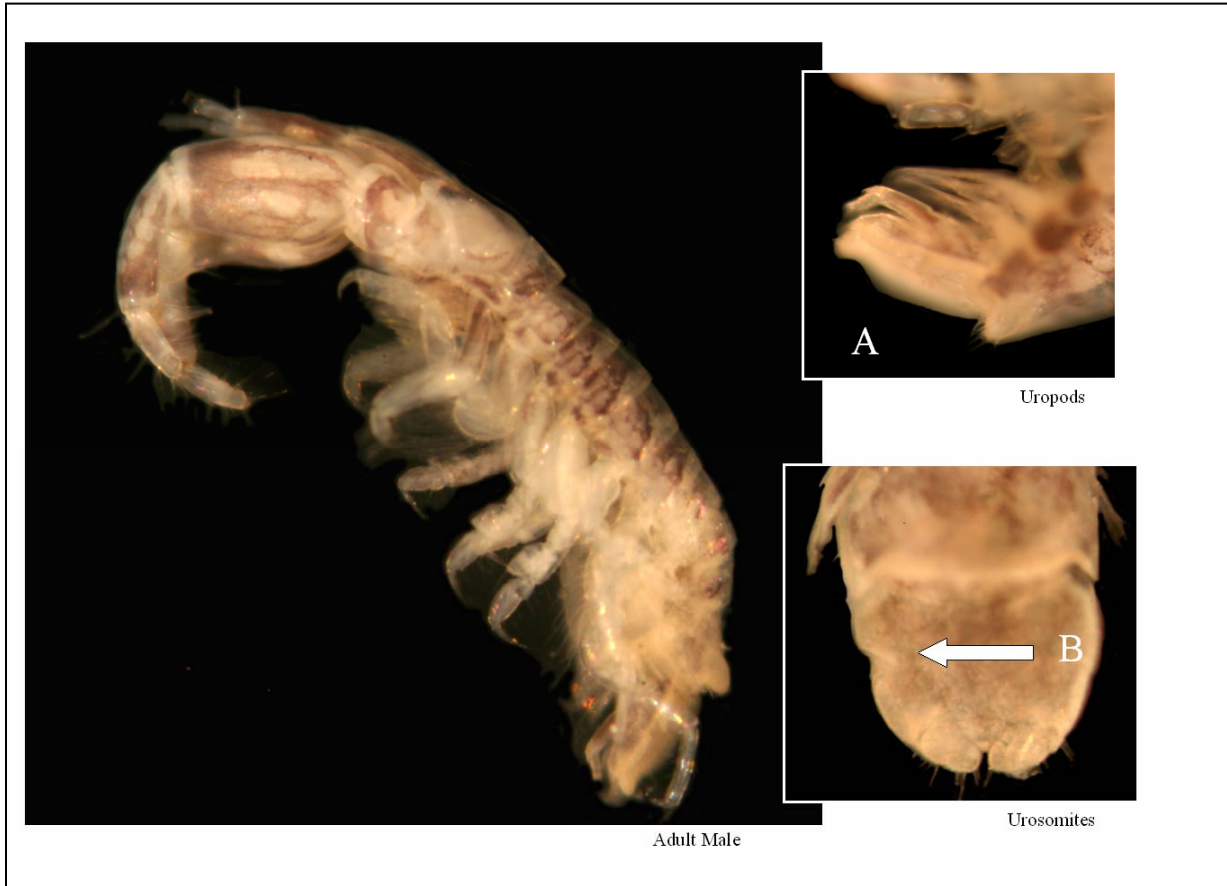


Figure 7: *Laticorophium baconi* A. Uropod 1 attached ventrally; B. Posterolateral margins of urosome upturned slightly as a rim, with a median notch.

Laticorophium baconi Shoemaker, 1934

Distinguishing characteristics

A. Uropod 1 attached ventrally

B. Posterolateral margins of urosome upturned slightly as a rim, with a median notch

Condition

Antennae 1 missing.

Description

Male: Pleosome segment 3 with slight posterior marginal elevation. Urosome short, broad, with convex lateral margin, entire except for slight not posterior to ventral insertion of Uropod 1. Head, rostrum short, basally broad, tip not exceeding lateral head lobes. Antennae 1 slender; peduncular segment 1 with 2 proximo-medial and 3-4 posterior marginal spines; segments 1 and 2 strongly setose posteriorly; segment 3 short; flagellum 3 segmented. Antennae 2 short, strongly pediform; segment 4 deep, nearly

smooth below; peduncular segment 5 shorter than segment 4, with distinct distal median tooth and strong curved distal process; flagellum medium, 3 segmented; posterior margin of segment 5 and flagellum strongly setose. Gnathopod 1, propod margins subparallel; dactyl with small posterior marginal tooth, tip distinctly exceeding short palm. Gnathopod 2, basis stout; carpus short, with distinct posterodistal free margin; propod strong, lacking palm or posterodistal cusp; dactyl with a single posterior marginal tooth and a few setae. Peraeopods 3 and 4, bases broad (3 slightly narrower than 4), anterior margin nearly bare; segment 4 distally medium broad, strongly overhanging short segment 5, anterior margin of 4 nearly bare; dactyl slender, subequal in length to segment 6. Pereopod 5, posterior margin of basis nearly bare. Pereopod 7 not elongate; basis medium broad; segment 6 with 2 distal clusters of long setae; dactyl short. Pleon plates 1 and 2 with long marginal setae; pleon plate 3 setose behind. Uropod 1, rami short, unequal, each with 2-4 outer marginal spines. Uropod 2 small, outer ramus with 3-4, inner ramus with 1-2, slender outer marginal spines. Uropod 3, peduncle broad, with distinct setose lateral lobe; ramus short, narrowing and rounded apically. Telson little broader than long, narrowing distally, with 4 posterodorsal pairs of small hook spines. Female: Rostrum and antenna 1 much as in male. Antenna 2 dissimilar to that of male; peduncular segments 3 and 4 with short posterior marginal spines; segment 5 shorter than 4, margins weakly setose, margin of segment 5 with 3 pairs of strong spines; flagellum short with few seta. (Bousfield, 1997)

Family Eusiridae

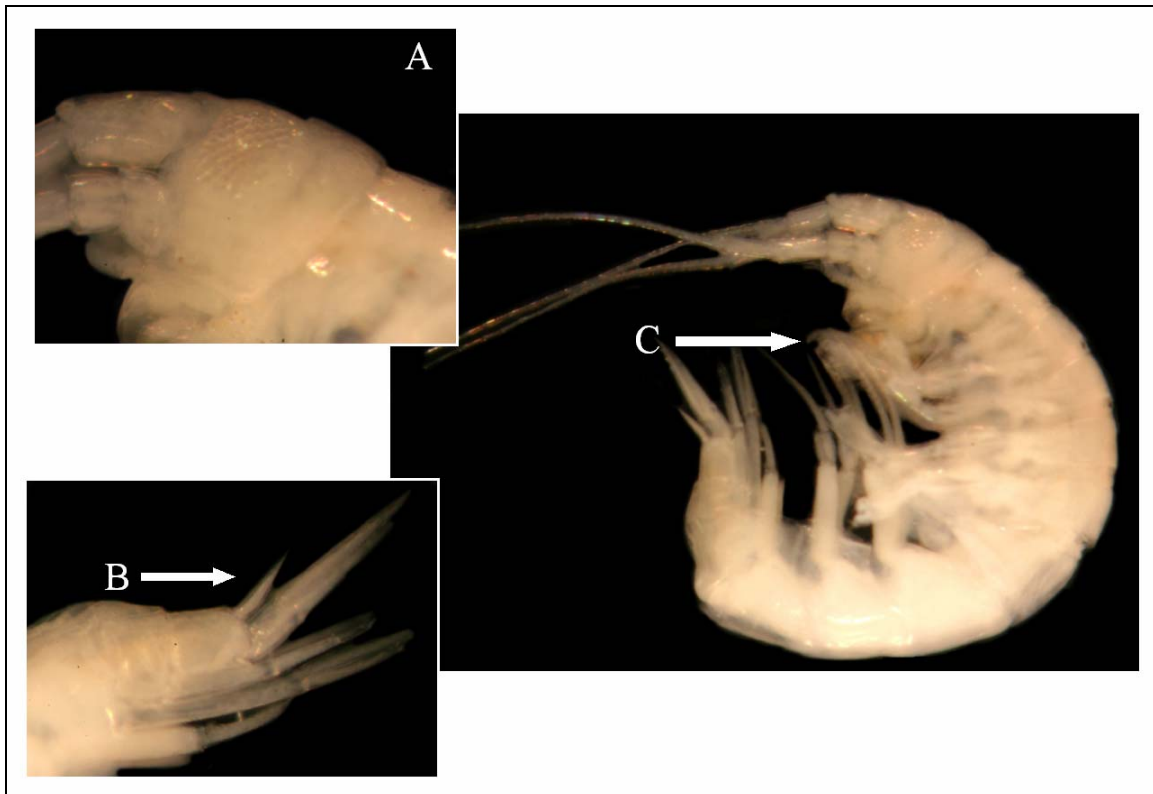


Figure 8. *Pontogeneia intermedia* A. Eyes large; B. Thin, laminar and cleft telson; C. Gnathopods small and subchelate.

Pontogeneia intermedia Guaranova, 1968

Distinguishing characteristics

- A. Eyes large
- B. Telson, thin laminar and cleft
- C. Gnathopods small and subchelate

Condition

Not all pereopods in tact.

Description

Accessory flagellum absent; lower lip with small inner lobes; inner plate of maxilla 1 with four or more terminal or subterminal setae; gnathopods not eusrid*, article 5 not lobate, slightly longer than article 6; pereopods 3-5 with articles 4-6 each not longer than article 2; telson thin, cleft, laminar. (Barnard, 1969)

* "Eusrid Gnathopods": article 6 of gnathopods attached to the strongly produced or extended apex of article 5, article 6 as broad as long

Family Ischyroceridae



Figure 9. *Jassa marmorata* A. Gnathopod 2 with large posterior thumb-like expansion opposite the dactylus; B. Eyes are small, less than $\frac{1}{4}$ head; C. Gnathopod 2 with plumose setae.

Jassa marmorata Holmes, 1903

* Invasive in Morro Bay

Distinguishing characteristics

A. Gnathopod 2 with large posterior thumb-like expansion opposite to the dactylus

B. Eyes are small (less than $\frac{1}{4}$ head length)

C. Gnathopod 2 with plumose (feather-like) setae

Description

Male, 8.0 mm. Head. Eyes small (distinctly less than $\frac{1}{4}$ head length), situated entirely within the lateral lobe of the head or partially within the lateral lobe of the head. Rostrum absent. Lateral cephalic lobes rounded. Labrum epistome present. Mandibular palp with three articles, article 3 medially broad, distinctly shorter than article 2. Antenna 1 peduncular article 1 distinctly shorter than article 3, not swollen or produced over article 2; flagellum subequal to peduncular article 3; accessory flagellum distinct and 12 articulate. Antenna 2 long ($\frac{1}{2}$ body length and greater), peduncular articles 4-5 with 4 or more rows of setae per article; flagellum subequal or shorter than peduncular article 5. Pereon. Coxae 1-4 deep (similar depth to pereonites), overlapping, similar size. Coxa 1 distally acute. Coxa 2 as broad as deep, anterodistally produced, ventral margin without stridulating ridges. Gnathopod 1 distinctly different size from gnathopod 2; basis without knob-like process on posterior margin; carpus distinctly shorter than propodus; propodus

between 1.5 and 3 times as long as wide, posterodistal margin evenly rounded. Gnathopod 2 with plumose setae; carpus without distinct free posterior expansion; propodus very long (more than 2.5 times as long as carpus), elongate with large proximal posterior expansion, posterodistal margin without robust seta(e), with large proximal process or processes opposable to dactylus, with a single excavation; dactylus long (distinctly longer than half length of propodus). Pereopods 34 basis weakly expanded, almost linear; merus distinctly expanded. Pereopods 57 basis with few or no setae. Pereopod 56 dactylus without accessory spine. Pereopod 5 merus not expanded around carpus. Pleon.. Uropod 1 peduncle distal margin smooth, with spine; rami distinctly unequal in length (3/4 length or less). Uropod 2 biramous; peduncle with interamal spine (small); rami distinctly unequal in length. Uropod 3 biramous; peduncle not greatly distally expanded; outer ramus with terminal curved robust spines. Telson dorsal surface without patches of short robust setae. (Conlan, 1990)

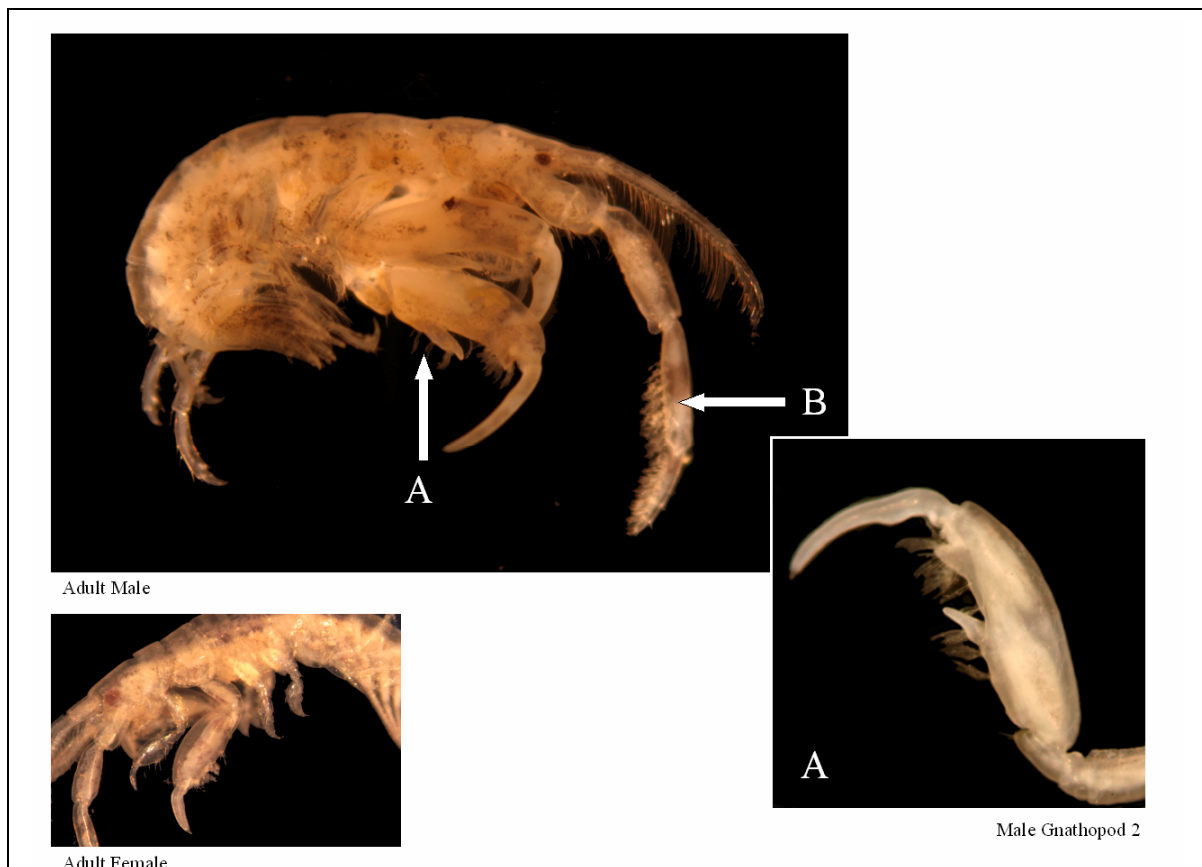


Figure 10. *Jassa slatteryi* A. Gnathopod 2 with small tooth next to origin of dactyl and a long thumb like tooth defining the palm; B. Large antennae with setae.

Jassa slatteryi Conlan, 1990

Distinguishing Characteristics

- A. Gnathopod 2 in Adult male; propodus palm with small tooth next to origin of dactyl and a long thumb-like tooth defining palm
- B. Large Antennae 2, setose

Description

Adult Male: Antenna 1 overlaps antenna 2 to about midway along segment 5. Antenna 2: segment 5, posterior margin bearing short, finely plumose brush setae, long filter setae lacking; flagellum proximally plumose, 4 segments, segment 1 is 66% of full length. Gnathopod 1: coxal margins, anterior 138% of dorsal length, ventral margin straight; basis, anterior and posterior margins with a single cluster of setae at distal angle; carpus, posterior lobe 40% of anterior margin length, setae in anterodistal cluster long, 73% of anterior margin length; propodus, palm shallowly concave; dactyl cusped along most of posterior margin, without facial striations. Gnathopod 2: coxal margins, anterior 41% and posterior 74% of ventral length; ventral margin sinuous; gill moderately large; basis, anterolateral flange with 17 short, simple filter setae (setae about 25% of width); carpus, posterior lobe without a distal seta; propodus, anterior margin with a few short setae proximally; palm, palmar setae concentrated at hinge tooth area; thumb 23% of propodus length, distally acute, posterior margin shallowly expanded at thumb setae and again at defining setae, defining setae well separated, not accompanied by spines; dactyl, inner margin shallowly expanded at location of hinge tooth. Pereopod 3: coax, greatest depth posterior to center; basis, anterior margin relatively straight; merus, anterior marginal setae nearly as long as segment width; carpus fully overlapped by merus; propodus, width 45% of length. Peraeopods 5-7: propodus not expanded anteriorly; dactyl without a fringe of short setae along anterior margin, without facial striations. Pleopods: with 2 peduncular coupling hooks. Uropod 1: peduncle, posteroventral spinous process underlying 27% of inner ramus, inner and outer rami with 4 and 5 mid-dorsal spines, respectively, terminating in a fringe of cusps ventral to apical spine group. Uropod 2: peduncle, posteroventral spinous process underlying 5% of inner ramus. Uropod 3: outer ramus with 2 sequential, closely approximated cusps proximal to basally immersed, dorsally recurved spine, serrations in area of cusps, and 1 sera originating at insertion of recurved spine; inner ramus with only the single apical spine. Telson: setose only at lateral cusps.

Adult Female: Antenna 2: segment 5, posterior margin with long filter setae, without plumose setae. Gnathopod 1: coax, ventral margin straight. Gnathopod 2: coxal margins, anterior 52% and posterior 86% of ventral length; ventral margin straight; propodus, hinge tooth pronounced, palmar setae moderately dense throughout but not so dense as to obscure the palm's shape, palmar angle acute and distal, but fairly close to defining spines; dactyl, inner margin shallowly expanded at hinge tooth, tip fitting into depression between palmar angle and defining spines. (Conlan, 1990)

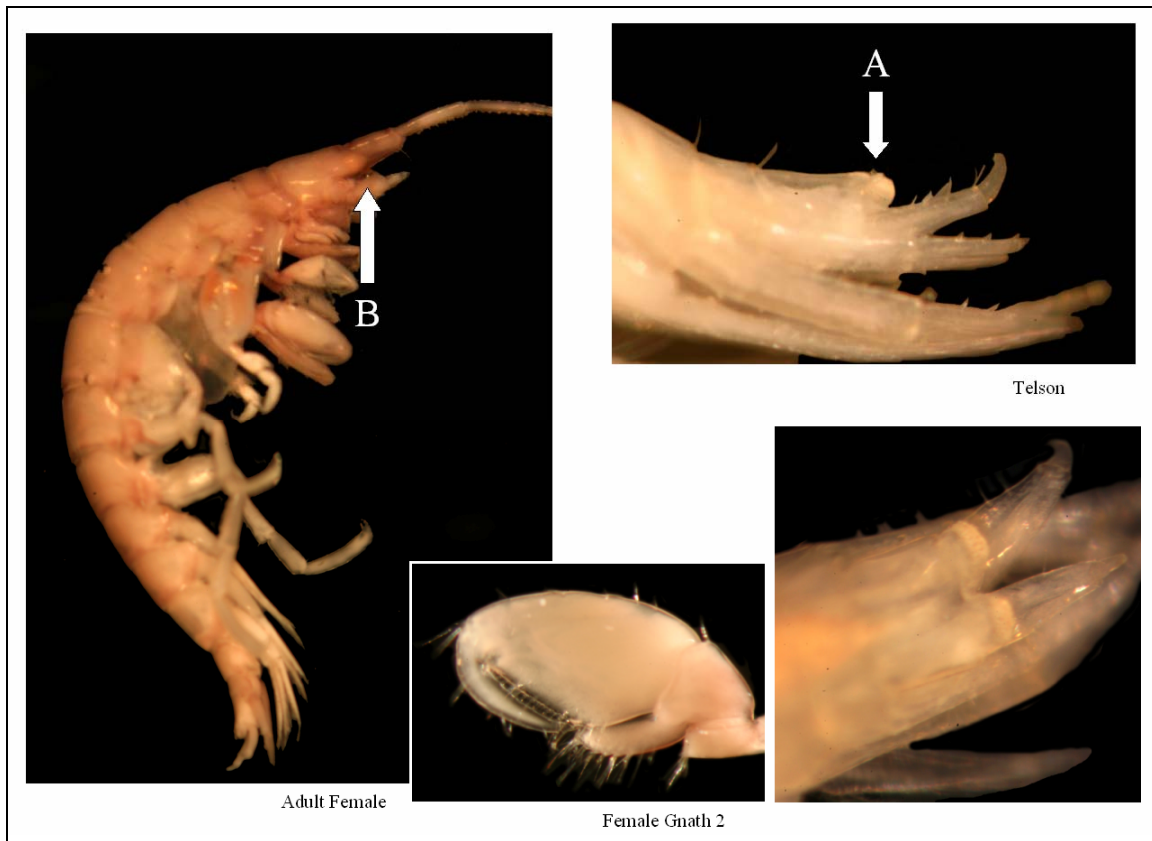


Figure 11. *Ericthonius brasiliensis* A. Short telson; B. Eyes partially within lateral lobes of head.

Ericthonius brasiliensis Dana, 1853

Distinguishing characteristics

- A. Short telson
- B. Eyes partially within lateral lobes of head

Condition

Adult female missing second antennae and some pereopods

Description

Adult Male: Head. Eyes small (distinctly less than 1/4 head length), partially within the lateral lobe of the head. Rostrum absent. Lateral cephalic lobes acute. Labrum epistome present. Mandibular palp with three articles, article 3 medially broad, distinctly shorter than article 2. Antenna 1 peduncular article 1 distinctly shorter than article 3, not swollen or produced over article 2; flagellum distinctly longer than peduncular article 3; accessory flagellum distinct and 12 articulate. Antenna 2 long (1/2 body length and greater), peduncular articles 45 with 4 or more rows of setae per article; flagellum subequal or shorter than peduncular article 5. Pereon. Coxae 1-4 shallow (less than depth of pereonites), not overlapping, with 1 or more coxae significantly different in size. Coxa 1 distinctly shorter than coxa 4, not distally acute. Coxa 2 distinctly broader than deep, not anterodistally produced, distinctly longer than coxa 4, ventral margin with stridulating ridges. Gnathopod 1 distinctly different size from gnathopod 2; basis with knob-like process on posterior margin; carpus distinctly longer than propodus; propodus

between 1.5 and 3 times as long as wide, posterodistal margin evenly rounded. Gnathopod 2 with simple setae; carpus with distinct free posterior expansion, margin extended into two or more spines; propodus shorter than carpus, short, rectangular, covered by posterior expansion of carpus, without large proximal process or processes opposable to dactylus; dactylus long (distinctly longer than half length of propodus). Pereopods 34 basis expanded, flask shaped; merus weakly or not expanded. Pereopods 57 basis with few or no setae. Pereopod 56 dactylus with accessory spine. Pereopod 5 merus not expanded around carpus. Pleon.. Uropod 1 peduncle distal margin comb-like, without interramal spine; rami subequal in length (more than 3/4 length). Uropod 2 biramous. Uropod 2 peduncle distal margin smooth. Uropod 2 peduncle without interramal spine; rami subequal in length. Uropod 3 uniramous; peduncle not greatly distally expanded. Telson dorsal surface with patches of short robust setae. (Myers, 1984)

Family Isaeidae



Figure 12. *Gammaropsis* sp.

Gammaropsis sp. Liljeborg, 1855

Condition

Brooding Female missing some pereopods and one of the second antennae.

Description

Accessory flagellum 3 or more articulate; article 3 of antenna 1 equal to or longer than article 1; gnathopods subchelate; uropod 3 biramous, rami equal to each other, variable in length, generally equal to or longer than peduncle. (Barnard, 1969)

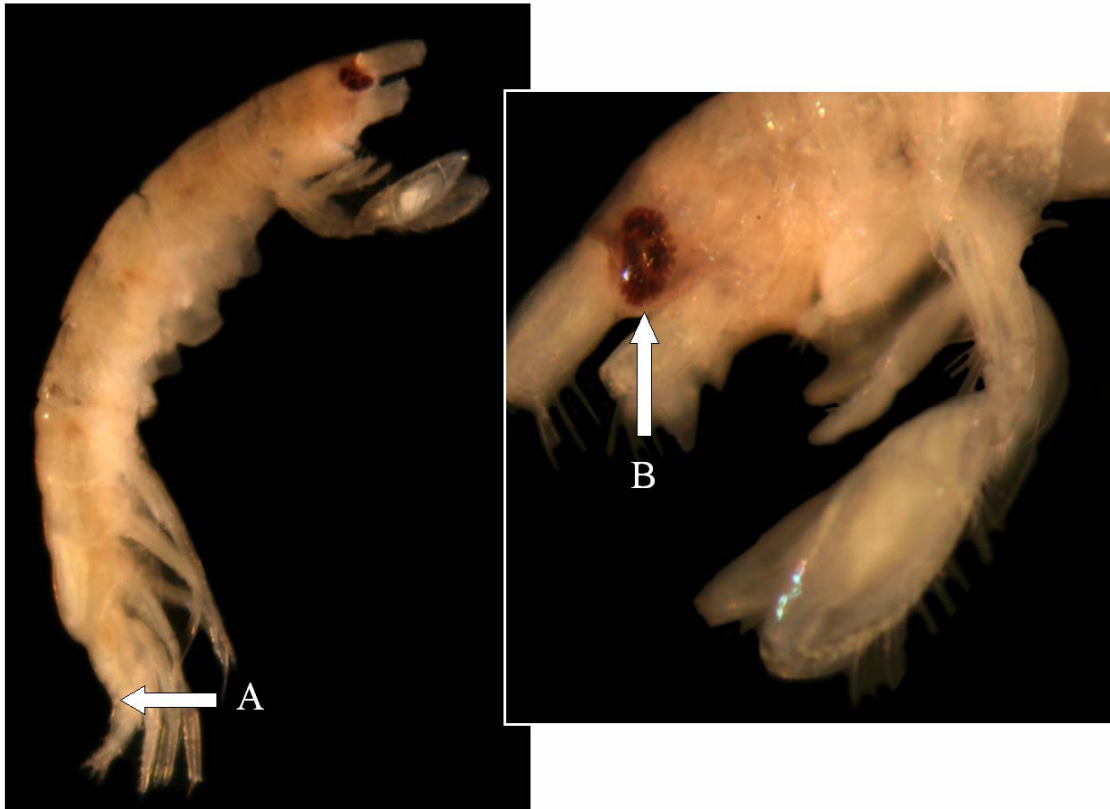


Figure 13. *Gammaropsis thompsoni*.

Gammaropsis thompsoni Walker, 1898

Distinguishing characteristics

- A. Urosome segments 1 and 2 dorsally cusped
- B. Eye kidney shaped
- C. Antenna 1 accessory flagellum long and multiarticulate (Antennae not shown)

Condition

Adult male missing pereopods 3-7, and both antennae.

Description

Head lobe triangular, anteriorly acute; eye black, kidney shaped; antennae 1 and 2 about equal in length; antennae 1 moderately setose, with long setae posteriorly, article 3 as long as article 1; accessory flagellum 8 articles. Antennae 2 moderately setose, with long setae, flagellum not pediform, longer than article 5, not distally spinose. Pereopods 1-4, coxae, ventral margins with minute setae only. Gnathopod 1 smaller than gnathopod 2; gnathopod 1, coxa similar in shape to but half depth of coxa 2; basis inserted midway on inner face, densely setose anterodistally; merus not extended as tooth as tooth under carpus; carpus somewhat shorter than propodus, anterior margin without setae, posterior lobe not expanded under propodus; propodus, palm oblique, defined by a single small spine; dactyl only as long as palm of propodus, posterior margin with few short setae and cusps. Gnathopod 2 larger than and different in shape from that of adult female and juvenile; basis without stridulation ridges; carpus nearly as long as propodus, not toothed;

propodus, palm transverse, with protuberance centrally and another at corner, but without palm defining spine, setae at dactyl hinge about one-fourth length of propodus; dactyl not toothed, overlapping palm. Pereopod 3, coxa without stridulation ridges on ventral margin. Pereopod 4, coxa, posterior margin not excavate. Peraeopods 3 and 4, basis not expanded, merus not wider than and not produced over carpus; dactyl not elongate, much shorter than propodus. Pereopod 5, coxa as deep as coxa 4; basis moderately broad, shallowly concave; merus not posteriorly excavate; merus and carpus with cluster of spines at posterior junction of propodus; propodus strongly spinose along anterior margin; dactyl not cusped. Pereopod 7, coxa (adult male) more than 3 time depth of coxa 6; coxa 7 (adult female and juvenile) not enlarged; otherwise pereopods 6 and 7 similar in shape to pereopod 5, although bases wider. Urosome segments 1 and 2 with pair of dorsally erect setae and cusps. Uropod 1, peduncle with row of lateral ecdysial spines and tooth-like process extending ventrally below rami; rami tipped by 2-4 spines. Uropod 3, peduncle dorsally spinose; outer ramus somewhat shorter than peduncle and tipped by 1-2 spines, inner ramus as long as outer, tipped by 1-2 spines. Telson apices marked by strong spine and short setae. (Blake et al 1995)

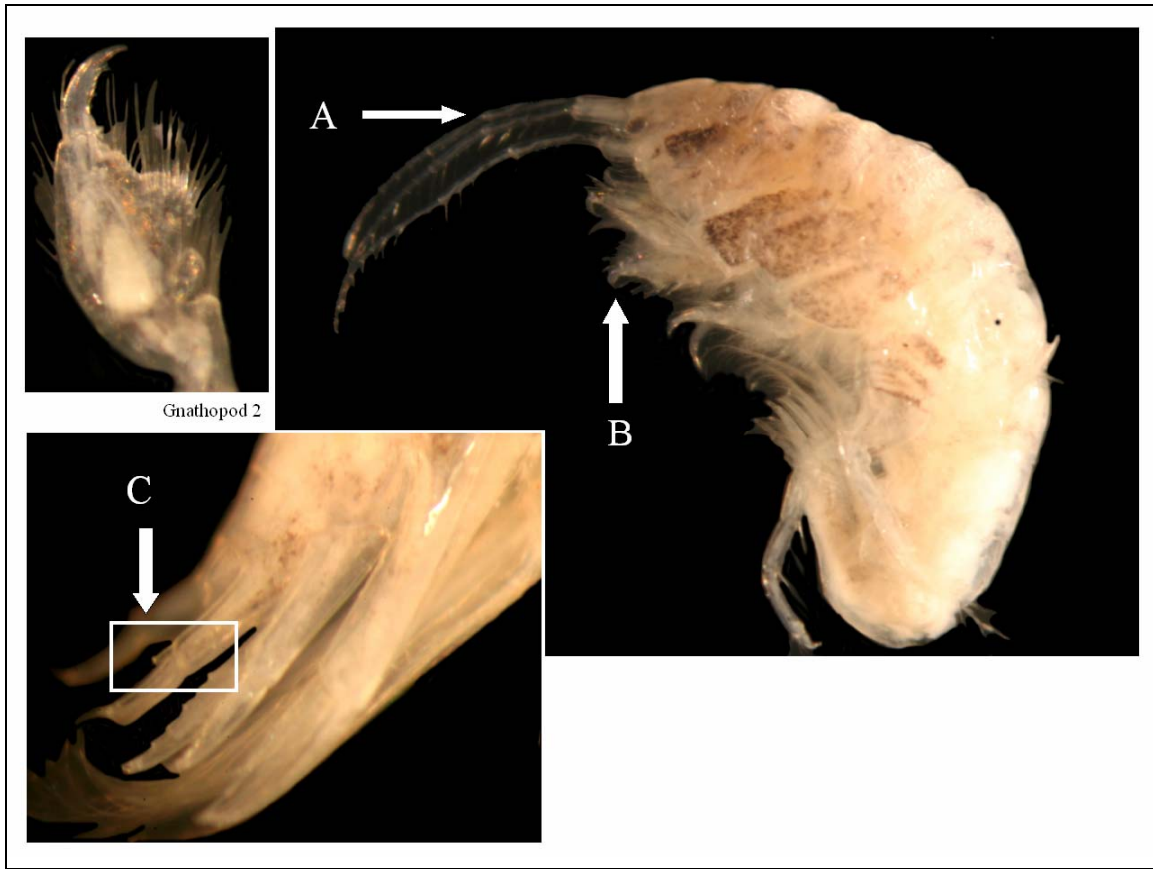


Figure 14. *Photis* sp. A. Antennae lacking accessory flagellum; B. Both Gnathopod 1 and Gnathopod 2 subchelate; C. Biramus uropods with Uropod 3 with one distinctly shorter ramus.

Photis sp. Kroyer, 1842

Distinguishing characteristics

- A. Lacking accessory flagellum
- B. Both Gnathopod 1 and 2 subchelate
- C. Biramus uropods, Uropod 3 with one distinctly short ramus

Condition

Adult Female

Description

Accessory flagellum absent or formed of a vestigial article or scale; article 3 of antennae 1 equal to or longer than article 1; gnathopods subchelate; uropod 3 biramous, outer ramus equal to or shorter than peduncle; inner ramus much shorter than outer ramus. (Barnard, 1969)

Family Melitidae

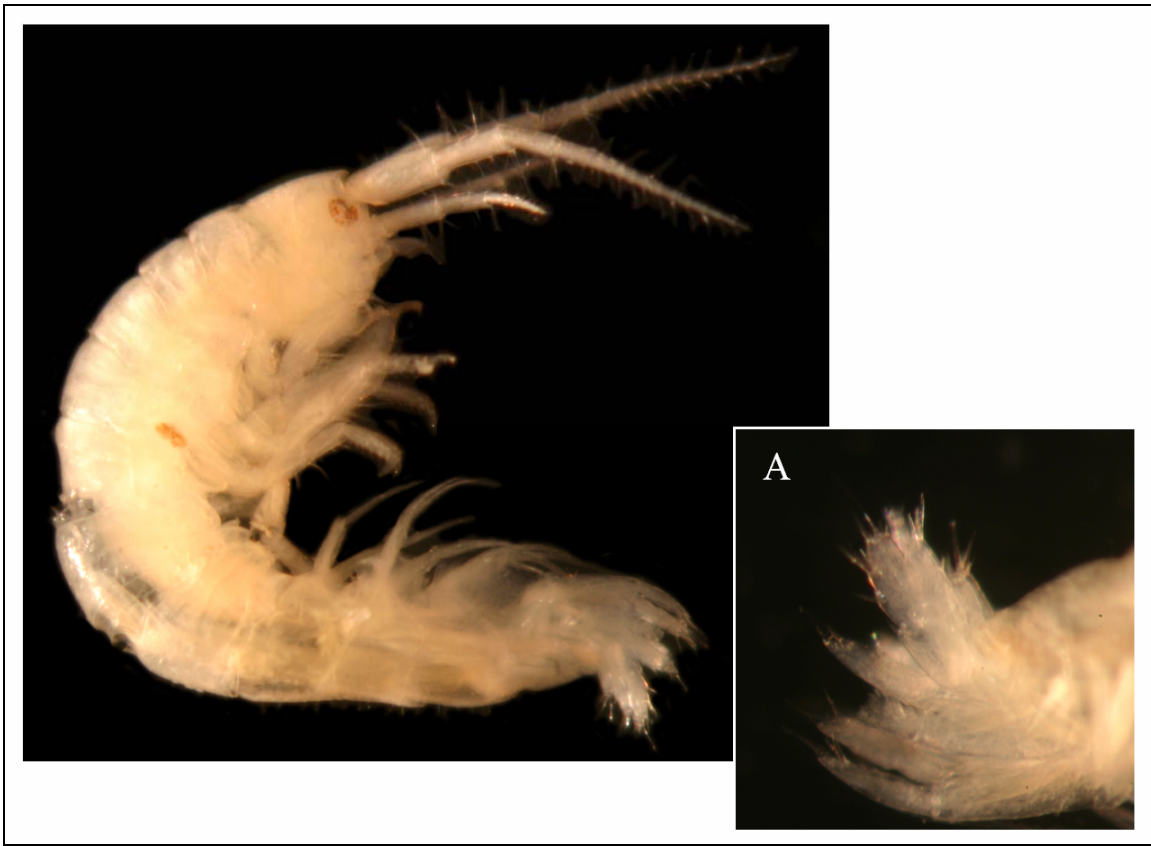


Figure 15. *Elasmopus* sp. A. Uropod 1 peduncle with 1-2 robust setae

Elasmopus sp. Costa, 1853

Distinguishing characteristics

A. Uropod 1 peduncle with robust setae

Description

Accessory flagellum 3- or more, occasionally 2-articulate; gnathopods normal; uropod 3 variable in length, rami equal, rectangular, outer 1-articulate; telson deeply cleft; urosome occasionally with dorsal teeth. (Barnard, 1969)

Family Podoceridae

Genus *Podocerus* Leach, 1814

Description

Body often dorsally corrugated or provided with elevations, teeth, humps, or carinate or smooth, depressed. Rostrum short, ocular lobes short, blunt, antennal sinus deep. Eyes vary from large to weak, and may bulge laterally. Antenna 1 shorter than 2, antenna 1 slender, antennae 2 stout; peduncular article 3 of antennae 1 longer than 1, article 2 the longest, accessory flagellum 1-2 articles. Antennae 2 peduncular article 3 scarcely elongate, peduncle moderately stout, flagellum short, poorly articulate. Coxa very small, short, weakly discontinuous, of various sizes and shapes. Gnathopods 1-2 diverse, gnathopod 2 greatly larger than gnathopod 1. Gnathopod 1 in adult males poorly subchelate, carpus shorter than or as long as propodus, weakly lobed. Gnathopod 2 enlarged, weakly subchelate or essentially simple, very setose, with basis barely dilated, merus enlarged, barely merochelate, extended and fused distally along posterior margin of carpus. Peraeopods 3-4 longer than gnathopods. Peraeopods 5-7 similar to each other, progressively slightly longer or pereopod 6 longer. Pleopods normal. Uropods 1-2 biramous, rami grossly unequal. Uropod 1, inner ramus as long as peduncle. Uropod 2, inner ramus much longer than peduncle. Urosomite 1 elongate. Uropod 3 forming flap lacking rami, very short, obtuse distally, with few armaments. Telson entire, short, broader than long, ovate or semicircular, spinose. (Barnard and Karaman, 1991)

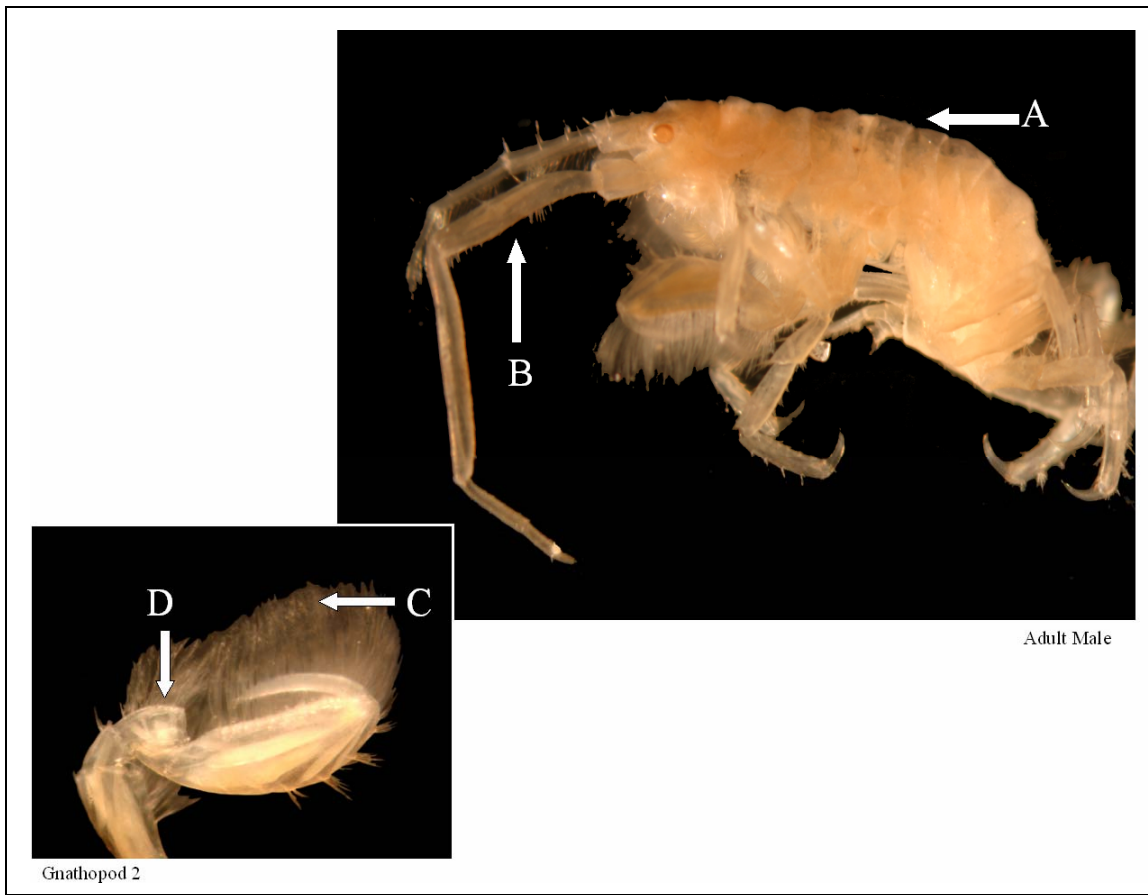


Figure 16. *Podocerus brasiliensis*. A. Perionites and pleonites smooth; B. Very long second antennae; C. Gnathopod 2 highly setose; D. Article 4 of male Gnathopod 2 does not project distally towards the dactyl.

Podocerus brasiliensis Dana, 1853

* Invasive to Morro Bay

Distinguishing characteristics

- A. Perionites and pleonites smooth
- B. Very long second antennae
- C. Gnathopod 2 highly setose
- D. Article 4 of male Gnathopod 2 does not project distally along the propodus towards the dactyl

Condition

Adult male missing one of the second antennae.



Figure 17. *Podocerus cristatus*. A. Pereonites and pleonites with sharp, dorsal keel teeth; B. Body shape similar to *P. brasiliensis*.

Podocerus cristatus Thomson, 1879

*Invasive to Morro Bay

Distinguishing Characteristics

- A. Pereonites 6-7 and pleonites 1-2 with sharp, dorsal keel teeth
- B. Body shape similar to *P. brasiliensis*

Condition

Missing all antennae and not all pereopods are present.

Description

Eyes large; pereonal segments 5-7 and pleonal segments 1-2 with distinct mid dorsal carinae, carina on 5 is weak, pereonites 3 and 4 with rudiments of a carina. Gnathopod 2, palm in male with 2 processes near distal end. Telson conical, with two long setae apically. (Blake et al, 1995)

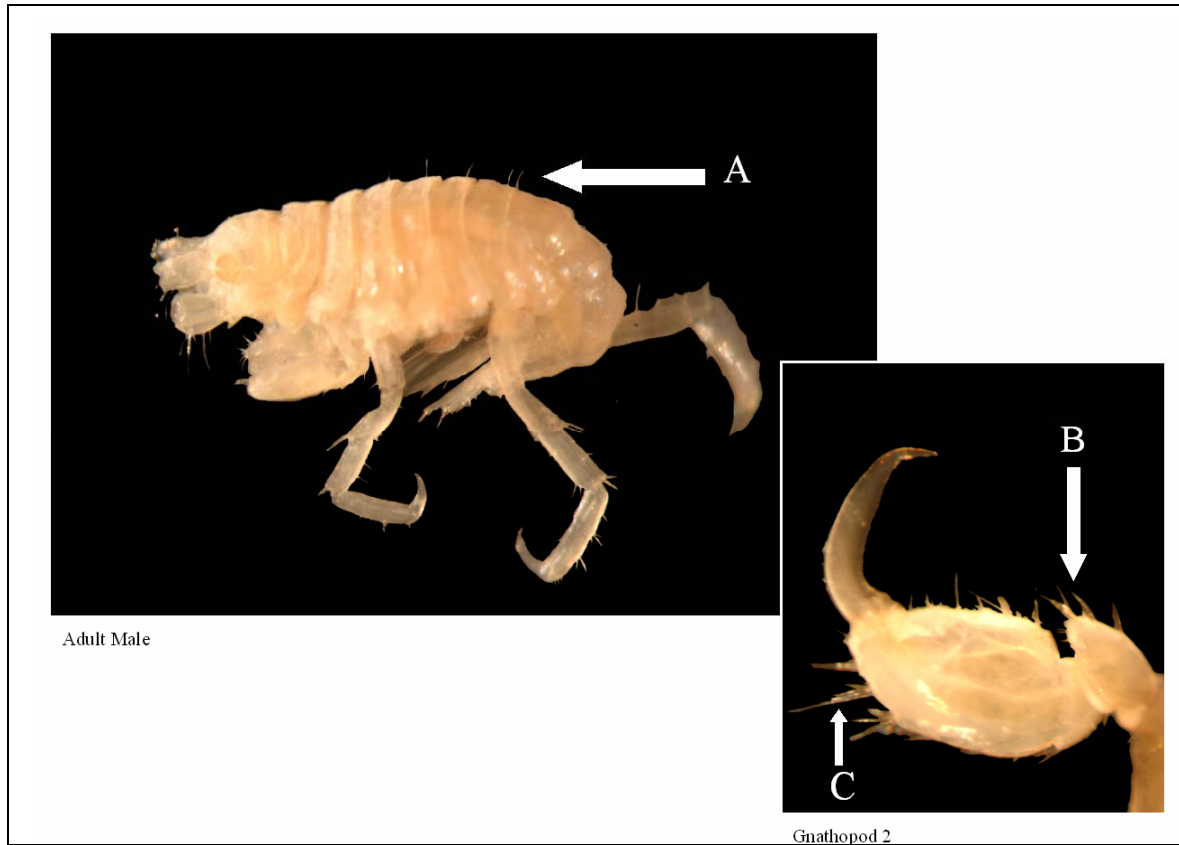


Figure 18. *Podocerus spongicolus*. A. Body form similar to *P. brasiliensis*; B. Article 4 of male Gnathopod 2 projects distally along hand towards dactyl; C. Gnathopod 2 with few setae.

Podocerus spongicolus Alderman, 1936

Distinguishing Characteristics

- A. Body shape similar to *P. brasiliensis*, smooth pereonites and pleonites
- B. Article 4 of male gnathopod 2 projecting distally along hand towards dactyl
- C. Sparsely setose Gnathopod 2

Condition

Missing all antennae and pereopods 4, 5, 6.

Family Stenothoidae

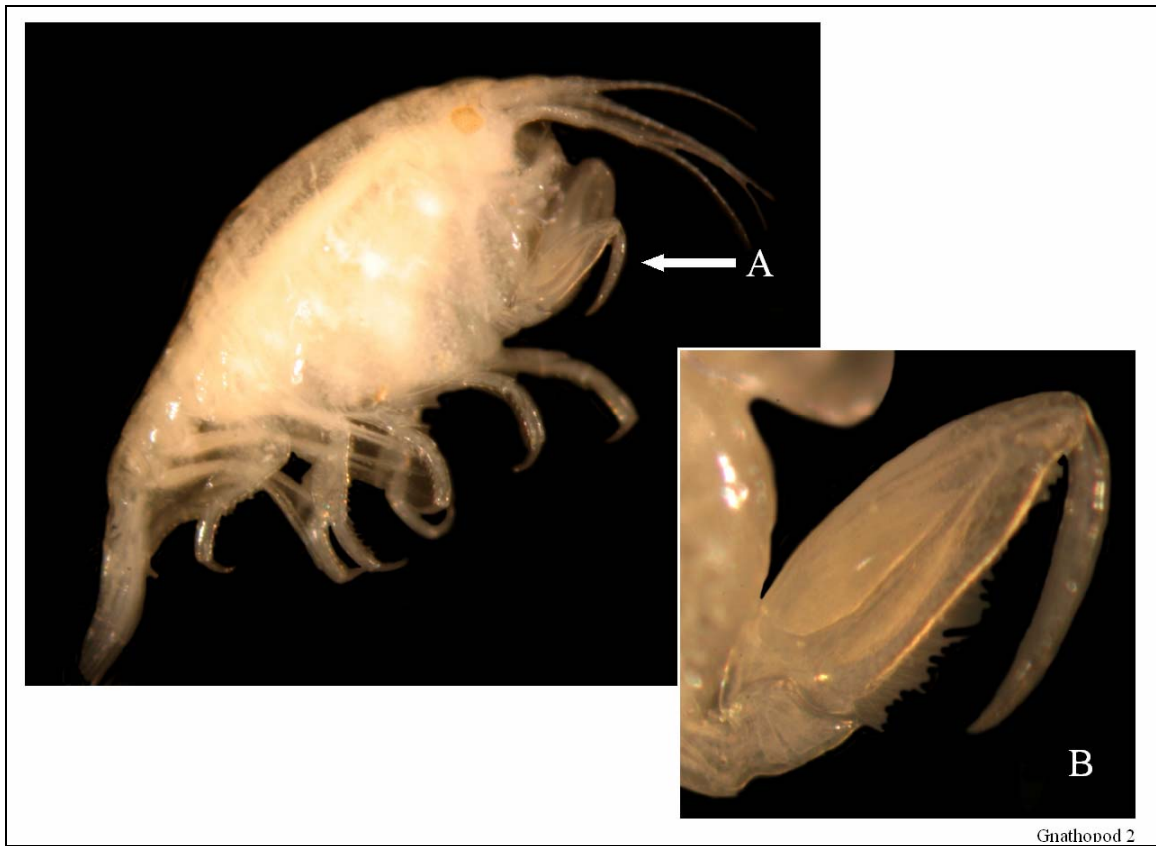


Figure 19. *Stenothoe freccanda*

Stenothoe freccanda Barnard, 1962

Distinguishing Characteristics

- A. Gnathopod 2 with dactyl as long as propodus
- B. Palm lined with short setae, not denticulate
- C. Coxae large and overlapping.

*Uropod 3 uniramus and telson with 3 lateral spines on each side

Description

Body not carinate. Gnathopod 1, merus strongly projecting distally and behind.

Gnathopod 2 elongate, with palm and posterior margin contiguous, bearing near finger a small triangular-shaped process with two smaller distal processes, the palm is lined with short setae, not denticulate, dactyl as long as propodus, stout lined on inner edge with short setae. Uropod 3, ramus, article 2 straight, not genticulate, the peduncle slightly longer than the ramus. Pereopods 5-7, article 4 of intermediate expansion. Telson with 3 lateral spines on each side. (Barnard, 1962c)



Figure 20. *Stenothoe estacola*

Stenothoe estacola Barnard, 1962

Condition

Missing some pereopods and has a tear in the main carapace.

Glossary

Revised from Barnard and Karaman 1991

Acute: shape: coming to a point.

Accessory flagellum: In some species an accessory flagellum is present, emerging from the end of the third article and can be both long and short (Barnard and Karaman, 1991).

Antenna 1: The first pair of antennae on the head. The first three articles are the peduncle with the rest of the articles known as the flagellum.

Antenna 2: The second pair of antenna located on the head. The first five articles form the peduncle and the rest of the articles are the flagellum.

Anterior and Posterior: a position: (relates to the body) anterior indicates that an appendage is located near the head end of the body as opposed to the rear end of the body (the posterior).

Article: the segment of an appendage.

Basis: Second article (from body) of leg or maxilliped or the sixth segment from distal end of limb.

Biramous: An appendage composed of two rami or branches.

Bisinate: shape: a margin possessing two concavities.

Carina: A keel-like or ridge structure, for example that found in some amphipods dorsally on the urosome.

Carpus: The fifth leg article from the body or the third article from distal end of leg.

Chelate (chelate, claw): When the propodus and dactylus form a pincer-like structure (the dactylus articulates against the propodus).

Cleft: Split or partially divided

Coalesced: To come together so as to form one whole, unite

Concave: shape: to curve inwards.

Convex: shape: to curve outwards.

Corneal lens: a biconvex cuticular body occurring in or on the cephalic surface

Coxa (sing), coxae (pl): First or proximal article of leg or maxilliped and is the segment of the leg directly attached to the sternite of body.

Dactyl (dactylus): Terminal or distal article of leg, sometimes modified into the movable finger of the cheliped (claw).

Denticulate: fine toothed or notched

Depressed: flattened dorsoventrally.

Distal: a position: (usually relates to the appendages and their position in regards to the body) distal is the part of the article furthest from the body

Dorsal: a position: (relates to the body) dorsal relates to the topside of the animal

Epimera (pl) Epimeron (sing): In amphipods this is the lateral projection of the pleonite(s).

Excavate: to form a cavity or hole in

Falcate: shape: sickle shaped, curved and tapering to a point.

Flange: A protruding rim or edge.

Ischium: The third segment of the leg from the body or the fifth article from distal end of leg (usually first large article of maxilliped).

Lateral: a position: the side, or outer edge of an article facing away from the body.

Medial: a position: usually the inside face of an article (that facing the body).

Merus: Fourth article from distal end of leg (can be called the 'arm' in gnathopods).

Nasiform: Having the shape of a nose

Oblique: a shape: slanting at an angle

Palm: Expansion of the disto-lateral edge of an article to form a chelate articulation with the next distal article. Commonly found on the propodus of gnathopods 1 and 2 but also found on the carpus (carpochelate), and merus (merochelate).

Peduncle: The three proximal segments of the antennule and the five proximal segments of the antenna.

Pereon: Thoracic segments 2-8 bearing the locomotory appendages, or pereopods (gnathopods 1 and 2, pereopods 3-7).

Pereonite: A single thoracic segment of the pereon.

Pereopod: locomatory appendage (or leg) of the pereon that consists of the following segments (in order from distally to proximally): coxa, basis, ischium, merus, carpus, propodus, dactylus. In amphipods the pereopods consist of the modified (chelate) gnathopods 1 and 2, and pereopods 3 to 7 which are locomotory.

Pleon: The first three segments of the abdomen (Barnard and Karaman, 1991). The pleon bears the pleopods.

Pleonites: the three individual segments of the pleon in amphipods.

Pleopods: paired biramous appendages (composed of a peduncle and two rami) on the three segments of the pleon. Each pair can be clasped together via small coupling hooks on the peduncles and used in amphipods for swimming (Barnard and Karaman, 1991).

Plumose: feather like, clumped

Propodus: Article 6 of the pereopod or the second article from distal end of the leg.

Proximal: a position: (usually relates to the appendages and their position in regards to the body) proximal is the part closest to the body.

Ramus (sing), Rami (pl): Branch of a limb or other appendage (commonly used for pleopods and uropods).

Rostrum: Anteromedial projection of frontal margin of head.

Serrate: Edged with toothlike projections, as in a saw.

Seta (sing), Setae (pl): Hair-like process of cuticle that is clearly articulated with the basal cuticle (see spine).

Somite: one of a series of similar body segments into which the animal may be divided longitudinally

Spine: A pointed out pocketing of the cuticle that is not articulated with the cuticle at its base

Sternal spines: A non-articulated projection from the mid-section of ventral surface.

Subacute: shape: a blunt point.

Subchelate: Article 6 of a gnathopod or pereopod having a distal palm against which Article 7 closes; a prehensile condition in which the palm is not produced to form a

finger. Complexly subchelate or complexly chelate refer to the formation of a false chela by protrusion of teeth, cusps, or lobes from articles other than the sixth (Barnard 1969)

Telson: the plate attached to the sixth abdominal segment (urosome 3) and covering the anus. The morphology of the telson (i.e. shape, ornamentation, degree of cleftness) is important to taxonomic keys.

Transverse: lying or being across, athwart

Truncate: shape: a blunt, squared off end.

Uropods: Paired (usually biramous but can be uniramous) appendages on the urosome. Sometimes used for swimming but usually used in the 'flipping' motion and to help the moulting process, as the rami can be armed with robust setae and spines (Barnard and Karaman, 1991).

Urosome: The last three segments of the abdomen, bears the uropods.

Uniramous: Composed of a single branch.

Ventral: a position: (relates to the body) the underside.

References

- Barnard, J.L., 1962c. Benthic Marine Amphipoda of Southern California: Families Amphilochidae, Leucothoidae, Stenothoidae, Agissidae, Hyalidae. *Pacific Naturalist* 3:116-163
- Barnard, J.L., 1969. The Families and Genera of Marine Gammaridean Amphipoda. *Bulletin of the United States national Museum*, 271: 1-535.
- Barnard, J.L., 1969. Gammaridean Amphipoda of the Rocky Intertidal of California: Monterey Bay to La Jolla. Smithsonian Institution Press, 1969, Bulletin, 258.
- Barnard, J.L. and G.S. Karaman, 1991. The Families and Genera of Marine Gammaridean Amphipoda (Except Marine Gammaroids). *Records of the Australian Museum*, 13(1&2): 1-866.
- Blake, J.A., et al. 1995. Taxonomic atlas of the benthic fauna of the Santa Maria Basin and western Santa Barbara Channel. Science Applications International Corporation. Vol. 12 of 14, the *Crustacea* part 3, *Amphipoda*.
- Bousfield, E.L. and P.M. Hoover. 1997. The Amphipod superfamily Corophioidea on the Pacific coast of North America. Part V. Family Corophiidae: Corophiinae, new subfamily. Systematics and distributional ecology. *Amphipacifica* 2(3): 67- 139.
- Conlan, K.E. and E.L. Bousfield, 1982. The amphipod superfamily Corophioidea in the northeastern Pacific region, Family Ampithoidae: systematics and distributional ecology. *Publications in Biological Oceanography, National Museums of Canada*, 10: 41-75.
- Conlan, K.E., 1990. Revision of the crustacean amphipod genus *Jassa* Leach (Corophioidea: Ischyroceridae). *Canadian Journal of Zoology*, 68: 2031-2075.
- Conlan, K.E., 1995. Thumbing doesn't always make the genus: revision of the *Microjassa* Stebbing (Crustacea: Amphipoda: Ischyroceridae) *Bulletin of Marine Science*, 57(2): 333-337.
- Dixon, I.M.T. and Moore, P.G. 1997. A comparative study on the tubes and feeding behavior of eight species of corophioid Amphipoda and the bearing on phylogenetic relationships within the Corophioidea. *Philosophical Transactions: Biological Sciences*, Volume 352, Issue 1349, pp. 93-112
- Kim, C.B. and Kim W. 1993. Phylogenetic relationships among gammaridean families and amphipod suborders. *Journal of Natural History*. 27, 933-946.
- Martin, J. W. and G. E. Davis. 2001. An updated Classification of the Recent Crustacea. *Natural History Museum of Los Angeles County Science Series* 39. Los Angeles, CA.

Myers, A.A. and D. McGrath. 1984. A revision of the north-east Atlantic species of *Erichthonius* (Crustacea: Amphipod). Journal of the Marine Biological Association of the U.K. 64: 379-400.

Myers, A.A. and J.K. Lowry 2003. A phylogeny and a new classification of the Corophiidea Leach, 1814 (Amphipoda). Journal of Crustacean Biology. 23, 443-485.

Rupert, E. E. and R. D. Barnes. 1994. Invertebrate Zoology, 6th ed. Saunders College Publishing, Fort Worth, TX.

Shoemaker, C.R., 1925. The Amphipoda collected by the United States Fisheries Steamer "Albatros" in 1911, chiefly in the Gulf of California, Scientific Results of the Expedition to the Gulf of California. Bulletin of the American Museum of Natural History, 52: 21–61.

Smith, R.I. and J.T. Carlton. 1975. Light's Manual: Intertidal Invertebrates of the Central California Coast. 3rd Edition. University of California Press.